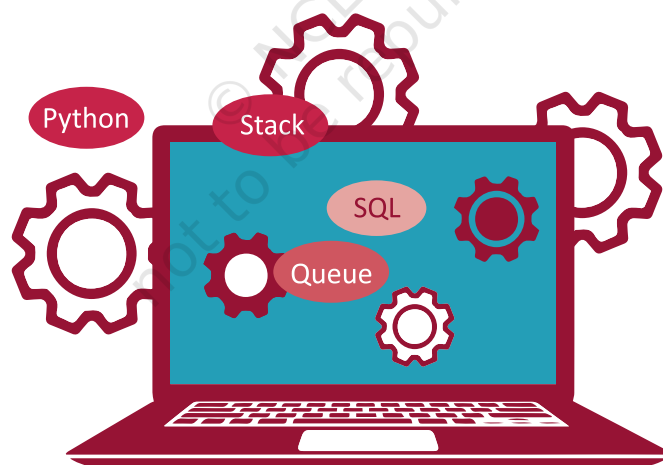


COMPUTER SCIENCE

TEXTBOOK FOR CLASS XII



12130



विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

ISBN 978-93-5292-338-0

First Edition

September 2020 Bhadrapada 1942

PD 50T BS

© **National Council of Educational
Research and Training, 2020**

₹ 150.00

Printed on 80 GSM paper with NCERT
watermark

Published at the Publication Division
by the Secretary, National Council of
Educational Research and Training,
Sri Aurobindo Marg, New Delhi 110 016
and printed at Chandra Prabhu Offset
Printing Works Pvt. Ltd., C-40, Sector-8,
Noida-201 301 (U.P.)

ALL RIGHTS RESERVED

- ❑ No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.
- ❑ This book is sold subject to the condition that it shall not, by way of trade, be lent, re-sold, hired out or otherwise disposed off without the publisher's consent, in any form of binding or cover other than that in which it is published.
- ❑ The correct price of this publication is the price printed on this page. Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

**OFFICES OF THE PUBLICATION
DIVISION, NCERT**

NCERT Campus
Sri Aurobindo Marg
New Delhi 110 016 **Phone : 011-26562708**

108, 100 Feet Road
Hosdakere Halli Extension
Banashankari III Stage
Bengaluru 560 085 **Phone : 080-26725740**

Navjivan Trust Building
P.O.Navjivan
Ahmedabad 380 014 **Phone : 079-27541446**

CWC Campus
Opp. Dhankal Bus Stop
Panihati
Kolkata 700 114 **Phone : 033-25530454**

CWC Complex
Maligaon
Guwahati 781 021 **Phone : 0361-2674869**

Publication Team

Head, Publication Division : *Anup Kumar Rajput*

Chief Editor : *Shveta Uppal*

Chief Production Officer : *Arun Chitkara*

Chief Business Manager (Incharge) : *Vipin Dewan*

Editor : *Bijnan Sutar*

Assistant Production Officer : *Mukesh Gaur*

Cover and Layout

Meetu Sharma, DTP Operator, DESM



FOREWORD

Computer science as a discipline has evolved over the years and has emerged as a driving force of our socio-economic activities. It has made continuous inroads into diverse areas — be it business, commerce, science, technology, sports, health, transportation or education. With the advent of computer and communication technologies, there has been a paradigm shift in teaching-learning at the school level. The role and relevance of this discipline is in focus because the expectations from the school pass-outs have grown to be able to meet the challenges of the 21st century. Today, we are living in an interconnected world where computer-based applications influence the way we learn, communicate, commute or even socialise!

There is a demand for software engineers in various fields like manufacturing, services, etc. Today, there are a large number of successful startups delivering different services through software applications. All these have resulted in generating interest for this subject among students as well as parents.

Development of logical thinking, reasoning and problem-solving skills are fundamental building blocks for knowledge acquisition at the higher level. Computer plays a key role in problem solving with focus on logical representation or reasoning and analysis.

This textbook focuses on the fundamental concepts and problem-solving skills while opening a window to the emerging and advanced areas of computer science. The newly developed syllabus has dealt with the dual challenge of reducing curricular load as well as introducing this ever evolving discipline. This textbook also provides space to Computational Thinking and Artificial Intelligence, which envisaged in National Education Policy, 2020.

As an organisation committed to systemic reforms and continuous improvement in the quality of its products, NCERT welcomes comments and suggestions which will enable us to revise the content of the textbook.

HRUSHIKESH SENAPATY
Director

National Council of Educational
Research and Training

New Delhi
August 2020

© NCERT
not to be republished



PREFACE

In the present education system of our country, specialised or discipline based courses are introduced at the higher secondary stage. This stage is crucial as well as challenging because of the transition from general to discipline-based curriculum. The syllabus at this stage needs to have sufficient rigour and depth while remaining mindful of the comprehension level of the learners. Further, the textbook should not be heavily loaded with content.

Computers have permeated in every facet of life. Study of basic concepts of computer science has been desirable in education. There are courses offered in the name of Computer Science, Information and Communication Technology (ICT), Information Technology (IT), etc., by various boards and schools up to secondary stage, as optional. These mainly focus on using computer for word processing, presentation tools and application software.

Computer Science (CS) at the higher secondary stage of school education is also offered as an optional subject. At this stage, students usually opt for CS with an aim of pursuing a career in software development or related areas, after going through professional courses at higher levels. Therefore, at higher secondary stage, the curriculum of CS introduces basics of computing and sufficient conceptual background of Computer Science.

The primary focus is on fostering the development of computational thinking and problem-solving skills. This book has 13 chapters covering the following broader themes:

- Data Structure: understanding of important data structure Stack, Queue; Searching and Sorting techniques.
- Database: basic understanding of data, database concepts, and relational database management system using MySQL. Structured query language—data definition, data manipulation and data querying.
- Programming: handling errors and exceptions in programs written in Python; handling files and performing file operations in Python.
- Network and Communication: fundamentals of Computers networks, devices, topologies, Internet, Web and IoT, DNS. Basics of Data communication—transmission channel, media; basics of protocols, mobile communication generations.
- Security Aspects: introduction to basic concepts related to network and Internet security, threats and prevention.

Each chapter has two additional components—(i) activities and (ii) think and reflect for self assessment while learning as well as to generate further interest in the learner. A number of hands-on examples are given to gradually explain methodology to solve different types of problems across the Chapters. The programming examples as well as the exercises in the

chapters are required to be solved in a computer and verify with the given outputs.

Box items are pinned inside the chapters either to explain related concepts or to describe additional information related to the topic covered in that section. However, these box-items are not to be assessed through examinations.

Project Based Learning given at the end includes exemplar projects related to real-world problems. Teachers are supposed to assign these or similar projects to be developed in groups. Working in such projects may promote peer-learning, team spirit and responsiveness.

The chapters have been written by involving practicing teachers as well as subject experts. Several iterations have resulted into this book. Thanks are due to the authors and reviewers for their valuable contribution. I would like to place on record appreciation for Professor Om Vikas for leading the review activities of the book as well as for his guidance and motivation to the development team throughout. Comments and suggestions are welcome.

New Delhi

20 August 2020

Rejaul Karim Barbhuiya

Assistant Professor

Central Institute of

Educational Technology



TEXTBOOK DEVELOPMENT COMMITTEE

CHIEF ADVISOR

Om Vikas, *Professor (Retd.)*, Former Director, ABV-IIITM, Gwalior, M.P.

MEMBERS

Anju Gupta, *Freelance Educationist*, Delhi

Anuradha Khattar, *Assistant Professor*, Miranda House, University of Delhi

Chetna Khanna, *Freelance Educationist*, Delhi

Faheem Masoodi, *Assistant Professor*, Department of Computer Science, University of Kashmir

Harita Ahuja, *Assistant Professor*, Acharya Narendra Dev College, University of Delhi

Mohini Arora, *HOD, Computer Science*, Air Force Golden Jubilee Institute, Subroto Park, Delhi

Mudasir Wani, *Assistant Professor*, Govt. College for Women Nawakadal, Sri Nagar, Jammu and Kashmir

Naeem Ahmad, *Assistant Professor*, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh

Purvi Kumar, *Co-ordinator*, Computer Science Department, Ganga International School, Rohtak Road, Delhi

Priti Rai Jain, *Assistant Professor*, Miranda House, University of Delhi

Sangita Chadha, *HOD, Computer Science*, Ambience Public School, Safdarjung Enclave, Delhi

Sharanjit Kaur, *Associate Professor*, Acharya Narendra Dev College, University of Delhi

MEMBER-COORDINATOR

Rejaul Karim Barbhuiya, *Assistant Professor*, CIET, NCERT, Delhi



ACKNOWLEDGEMENTS

The National Council of Educational Research and Training acknowledges the valuable contributions of the individuals and organisations involved in the development of Computer Science textbook for Class XII.

The Council expresses its gratitude to the syllabus development team including MPS Bhatia, *Professor*, Netaji Subhas Institute of Technology, Delhi; T. V. Vijay Kumar, *Professor*, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi; Zahid Raza, *Associate Professor*, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi; Vipul Shah, *Principal Scientist*, Tata Consultancy Services, and the CSpathshala team; Aasim Zafar, *Associate Professor*, Department of Computer Science, Aligarh Muslim University, Aligarh; Faisal Anwer, *Assistant Professor*, Department of Computer Science, Aligarh Muslim University, Aligarh; Smruti Ranjan Sarangi, *Associate Professor*, Department of Computer Science and Engineering, Indian Institute of Technology, Delhi; Vikram Goyal, *Associate Professor*, Indraprastha Institute of Information Technology (IIIT), Delhi; and Mamur Ali, *Assistant Professor*, Department of Teacher Training and Non-formal Education (IASE), Faculty of Education, Jamia Millia Islamia, New Delhi.

The Council is thankful to the following resource persons for providing valuable inputs in developing this book—Veer Sain Dixit, *Assistant Professor*, Atma Ram Sanatan Dharma College, University of Delhi; Mukesh Kumar, DPS RK Puram, Delhi; Aswin K. Dash, Mother's International School, Delhi; Anamika Gupta, *Assistant Professor*, Shaheed Sukhdev College of Business Studies, University of Delhi, Sajid Yousuf Bhat, *Assistant Professor*, University of Kashmir, Jammu and Kashmir.

The council is grateful to Prof. Sunita Farkya, *Head*, Department of Education in Science and Mathematics, NCERT and Prof. Amarendra P. Behera, *Joint Director*, CIET, NCERT for their valuable cooperation and support throughout the development of this book.

The Council also gracefully acknowledges the contributions of Meetu Sharma, *Graphic Designer cum DTP Operator*, Kanika Walecha, *DTP Operator*, Pooja, *Junior Project Fellow*; in shaping this book. The contributions of the office of the APC, DESM and Publication Division, NCERT, New Delhi, in bringing out this book are also duly acknowledged.

The Council also acknowledges the contribution of Ankeeta Bezboruah *Assistant Editor* (Contractual) Publication Division, NCERT for copy editing this book. The efforts of Naresh Kumar, *DTP Operator* (Contractual), Publication Division, NCERT are also acknowledged.



CONTENTS

FOREWORD	iii
PREFACE	v
CHAPTER 1 EXCEPTION HANDLING IN PYTHON	1
1.1 Introduction	1
1.2 Syntax Errors	1
1.3 Exceptions	3
1.4 Built-in Exceptions	3
1.5 Raising Exceptions	4
1.6 Handling Exceptions	7
1.7 Finally Clause	13
CHAPTER 2 FILE HANDLING IN PYTHON	19
2.1 Introduction to Files	19
2.2.Types of Files	20
2.3 Opening and Closing a Text File	21
2.4 Writing to a Text File	23
2.5 Reading from a Text File	25
2.6 Setting Offsets in a File	28
2.7 Creating and Traversing a Text File	29
2.8 The Pickle Module	32
CHAPTER 3 STACK	39
3.1 Introduction	39
3.2 Stack	40
3.3 Operations on Stack	42
3.4 Implementation of Stack in Python	43
3.5 Notations for Arithmetic Expressions	46
3.6 Conversion from Infix to Postfix Notation	47
3.7 Evaluation of Postfix Expression	49
CHAPTER 4 QUEUE	53
4.1 Introduction to Queue	53
4.2 Operations on Queue	55

4.3 Implementation of Queue using Python	56
4.4 Introduction to Deque	59
4.5 Implementation of Deque Using Python	61
CHAPTER 5 SORTING	67
5.1 Introduction	67
5.2 Bubble Sort	68
5.3 Selection Sort	71
5.4 Insertion Sort	74
5.5 Time Complexity of Algorithms	77
CHAPTER 6 SEARCHING	81
6.1 Introduction	81
6.2 Linear Search	82
6.3 Binary Search	85
6.4 Search by Hashing	90
CHAPTER 7 UNDERSTANDING DATA	97
7.1 Introduction to Data	97
7.2 Data Collection	101
7.3 Data Storage	102
7.4 Data Processing	102
7.5 Statistical Techniques for Data Processing	103
CHAPTER 8 DATABASE CONCEPTS	111
8.1 Introduction	111
8.2 File System	112
8.3 Database Management System	115
8.4 Relational Data Model	120
8.5 Keys in a Relational Database	123
CHAPTER 9 STRUCTURED QUERY LANGUAGE (SQL)	131
9.1 Introduction	131
9.2 Structured Query Language (SQL)	131
9.3 Data Types and Constraints in MySQL	133
9.4 SQL for Data Definition	134
9.5 SQL for Data Manipulation	141
9.6 SQL for Data Query	144
9.7 Data Updation and Deletion	154
9.8 Functions in SQL	156
9.9 GROUP BY Clause in SQL	167

9.10 Operations on Relations	169
9.11 Using Two Relations in a Query	172
CHAPTER 10 COMPUTER NETWORKS	181
10.1 Introduction to Computer Networks	181
10.2 Evolution of Networking	183
10.3 Types of Networks	184
10.4 Network Devices	187
10.5 Networking Topologies	191
10.6 Identifying Nodes in a Networked Communication	194
10.7 Internet, Web and the Internet of Things	195
10.8 Domain Name System	197
CHAPTER 11 DATA COMMUNICATION	203
11.1 Concept of Communication	203
11.2 Components of data Communication	204
11.3 Measuring Capacity of Communication Media	205
11.4 Types of Data Communication	206
11.5 Switching Techniques	208
11.6 Transmission Media	209
11.7 Mobile Telecommunication Technologies	215
11.8 Protocol	216
CHAPTER 12 SECURITY ASPECTS	223
12.1 Threats and Prevention	223
12.2 Malware	224
12.3 Antivirus	230
12.4 Spam	231
12.5 HTTP vs HTTPS	231
12.6 Firewall	232
12.7 Cookies	233
12.8 Hackers and Crackers	234
12.9 Network Security Threats	235
CHAPTER 13 PROJECT BASED LEARNING	241
13.1 Introduction	241
13.2 Approaches for Solving Projects	242
13.3 Teamwork	243
13.4 Project Descriptions	245

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a ¹**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the ²[unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)